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NASA COOPERATIVE AGREEMENT NCCI-22

COMPUTATIONAL FLUID MECHANICS

Final Report

September 20, 1994

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(NASA-CR-196858) COMPUTATIONAL
FLUID MECHANICS Final Report
(North Carolina Univ.) 4 p

N95-70302

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The final report consists of two lists. The first is a list of publications generated under this cooperative agreement, while the second is a list of students supported in part by this cooperative agreement and the degrees they received.

Publications Supported, in Part, by NASA Cooperative Agreement NCCI-22

- "Transonic Flow Calculations Using Euler's Equations," H. L. Atkins and H. A. Hassan, AIAA Paper 82-0106, January 1982; also, *AIAA Journal*, Vol. 21, No. 6, June 1983, pp. 842-847.
- "Heating Analysis of Bent-Nose Biconics at High Angles of Attack Using the Parabolized Navier-Stokes equations," B. L. Stephenson and H. A. Hassan, AIAA Paper 83-1507, June 1983.
- "A New Stream Function Formulation for the Euler Equations," H. L. Atkins and H. A. Hassan, AIAA Paper 83-1507, July 1984. Also, *AIAA Journal*, Vol. 23, May 1985, pp. 701-706.
- "Transonic Flow Calculations Using a Flux Vector Splitting Method for the Euler Equations," C. M. Seaford and H. A. Hassan, AIAA Paper 84-0090, January 1984.
- "Embedded Shear Layer Computations for Increased Drag Reduction," R. M. McInville, T. B. Gatski and H. A. Hassan, AIAA Paper 84-0349, January 1984.
- "Euler Calculations for Multielement Airfoils Using Cartesian Grids," D. K. Clarke, M. D. Salas and H. A. Hassan, AIAA Paper 85-0291, January 1985. Also, *AIAA Journal*, Vol. 24, pp. 353-358, March 1986.
- "Application of a Variational Scheme for Generating Adaptive Grids," R. I. Kreis, F. C. Thames and H. A. Hassan, AIAA Paper 85-0487, January 1985. Also, *AIAA Journal*, Vol. 24, pp. 404-410, March 1986.
- "Assessment of Wind Tunnel Corrections for Multielement Airfoils at Transonic Speeds," R. L. Gaffney, Jr., M. D. Salas and H. A. Hassan, *Third Symposium on the Numerical and Physical Aspects of Aerodynamic Flow*, January 1985.
- "Mixing Layer Control for Tangential Slot Injection in Turbulent Flows," R. M. McInville, W. L. Goodman and H. A. Hassan, AIAA Paper 85-0541, March 1985.
- "Analysis of Large Vortical Structures in Shear Layers," R. M. McInville, J. B. Gatski and H. A. Hassan, *AIAA Journal*, Vol. 23, August 1985, pp. 1165-1171.
- "Euler Calculations for Wings Using Cartesian Grids," R. L. Gaffney, Jr., M. D. Salas and H. A. Hassan, AIAA Paper 87-0356, January 1987.
- "Grid Embedding Technique Using Cartesian Grids for Euler Solutions," R. A. Mitcheltree, M. D. Salas, and H. A. Hassan, *AIAA Journal*, Vol. 26, pp. 754-756, June 1988.
- "Navier-Stokes Calculations Using Cartesian Grids: I. Laminar Flows," P. D. Frymier, H. A. Hassan, and M. D. Salas, *AIAA Journal*, Vol. 26, pp. 1181-1188, October 1988.

- "An Abbreviated Reynolds Stress Turbulence Model for Airfoil Flow", R. L. Gaffney, Jr., M. D. Salas, and H. A. Hassan, AIAA Paper 90-1468, June 1990.
- "A One-Equation Turbulence Model for Transonic Airfoil Flows," R. A. Mitcheltree, M. D. Salas, and H. A. Hassan, AIAA Paper 89-0557, January 1989; Also, *AIAA Journal*, Vol. 26, pp. 1625-1632, September 1990.
- "Use of Finite Volume Schemes for Transition Simulation," C. C. Fenno, Jr., C. L. Streett, and H. A. Hassan, AIAA Paper 91-0743, January 1991; Also, *AIAA Journal*, Vol. 30, pp. 1122-1125, April 1992.
- "A New Approach for the Calculation of Transitional Flows," T. Wayne Young, Eric S. Warren, Julius E. Harris, and H. A. Hassan, AIAA Paper 92-2669, June 1992; Also, *AIAA Journal*, Vol. 31, No. 4, pp. 629-636, April 1993.
- "A Transition Model for High Speed Flow", E. S. Warren, J. E. Harris and H. A. Hassan, AIAA Paper 94-1851, June 1994.
- "Numerical and Experimental Determination of Secondary Separation on Delta Wings in Subsonic Aircraft", *Journal of Aircraft*, Vol. 22, No. 7, July 1985, pp. 602-608 (F. R. DeJarnette and S. H. Woodson).
- "A Three Dimensional Boundary-Layer Method for Flow Over Delta Wings with Leading-Edge Separation", SAE Paper No. 851818, Oct. 1985 (F. R. DeJarnette and S. H. Woodson).
- "A Direct and Inverse Boundary-Layer Method for Subsonic Flow Over Delta Wings", in NASA Conference Publication, Vortex Flow Aerodynamics, Vols. I-III, NASA CP-2416, 2417, and 2418, March 1986 (F. R. DeJarnette and S. H. Woodson).
- "Interactive Three-Dimensional Boundary-Layer Method for Transonic Flow Over Swept Wings", AIAA Paper 89-0112, and *AIAA Journal*, Vol. 29, No. 5, May 1991, pp. 678-679 (F. R. DeJarnette, S. H. Woodson and J. F. Campbell).

Students Supported, in Part, by NASA Cooperative Agreement NCCI-22

| | <u>Name</u> | <u>Degrees Received</u> |
|-----|-----------------------|-------------------------|
| 1. | H. L. Atkins | M.S. Ph.D. |
| 2. | Beverly L. Stephenson | M.S. |
| 3. | C. M. Seaford | Ph.D. |
| 4. | S. Woodson | M.S. Ph.D. |
| 5. | R. I. Kreis | M.S. |
| 6. | D. K. Clarke | M.S. |
| 7. | R. L. Gaffney | M.S. Ph.D. |
| 8. | R. M. McInville | Ph.D. |
| 10. | C. C. Fenno, Jr. | Ph.D. |
| 11. | R. A. Mitcheltree | Ph.D. |
| 12. | P. D. Frymier | M.S. |
| 13. | Glenn McMillan | MME |
| 14. | T. W. Young | M.S. |
| 15. | E. S. Warren | M.S. |
| 16. | D. P. Robinson | M.S. |